uncertain, but where the observations were referred to it was found that "the two spots with the highest relative temperature were very near the sun's edge." He further suggests that if further observation should establish this fact, viz., that spots suffer less absorption than the neighbouring photosphere, we might consider them "to be in a higher stratum than the photosphere."

HYDROGEN SPECTRUM IN THE SOLAR ATMOSPHERE.—M. Deslandres, in the *Comptes Rendus* for July 25, communicates a brief note concerning the spectrum of hydrogen that was photographed by him in a prominence on the 4th of May last. This spectrum, besides containing many metallic lines, shows also ten ultra violet radiations of hydrogen and five other new ones, the latter of which, as he says, follow so regularly the former series that one is led to consider them as due to hydrogen. It may be remembered that Mr. Balmer indicated a simple function of whole numbers which represented exactly the series of 14 radiations of hydrogen. This function, which is applicable to most of the metals, is $N = A - \frac{B}{n^2}$ where N is the number of vibrations, A and B two constants, and n a whole number. In the following table we give the result of M. Deslandres' measures with regard to the new addition to this series, to show how close an agreement exists between the calculated and observed values :—

Whole Nos. of the formula n.	No. of vibrations		
	Deslandres.	Ames.	Calculated.
12	266·565	266·575	266·566
13	296·685	267·715	267·694
14	268·585	268·615	268·586
15	269·310	269·330	269·309
16	269·890	—	269·898
17	270·385	—	270·387
18	270·795	—	270·797
19	271·140	—	271·142
20	271·460	—	271·448
21	271·700	—	271·694

REFRACTION IN MICROMETRIC AND PHOTOGRAPHIC MEASURES.—A very simple method by which the effect of differential refraction may be eliminated from the results of micrometric observations or from the measures of photographic plates is given by Dr. S. C. Chandler in the *Astronomical Journal*, No. 271. The principle underlying this method is the position of the plate about to be measured, which here is inclined at a certain angle in the vertical direction to the focal plane of the telescope. In the measurement of distances this inclination necessitates the application of a small correction, but this is soon accomplished by the aid of a simple formula, which can be considerably modified by determining the screw revolution directly from the plate. One might at first think that by this means the stellar images would be slightly affected, but Dr. Chandler informs us that he thinks that "attentive examination will show that the difference of definition will be inappreciable."

THE RECENT EARTHQUAKES.

THE first of the earthquake shocks felt on the 18th inst. in Ireland, Wales, and the West of England was evidently one of unusual strength for this country, and it is very desirable that both it and the subsequent slighter shocks should be thoroughly investigated, with a view to discovering their origin and their relations to one another. As I have been engaged for several years in working at our British earthquakes, and am now occupied in studying these recent shocks, I should be greatly obliged if you would allow me to ask your readers who felt the shocks for assistance in obtaining the necessary materials.

It would be of great service to know simply the names of as many places as possible where one or more of the shocks were felt and the accompanying sounds heard. With this knowledge the boundaries of the disturbed area and the sound-area of each shock may be determined—points of considerable importance. But for a complete study of the shock it is desirable to have further details, such as would be given by answers to the questions printed below, especially to those numbered 3, 4, 6, and 7. I shall be most glad and thankful to receive accounts of the earthquakes from any place whatever, and I may add that no account, however scanty the information given, can fail to possess some value or to help in throwing light on the nature and origin of the shock.

(NOTE.—If more than one shock was felt it is important that the notes relating to each should be kept separate.)

(1) Name of place where the shock was felt.

(2) Situation of the observer: (*a*) Whether indoors (and on which floor of the house) or in open air: (*b*) How occupied at the moment of the shock.

(3) Time at which the shock was felt, if possible, to the nearest minute.

(4) Nature of the shock, description of the: (*a*) The number of vibrations: (*b*) Their relative intensity: (*c*) Whether there was any tremulous motion before or after the principal vibrations: (*d*) Whether any vertical motion was perceptible, and if so, whether the movement was first upward and then downward, or first downward and then upward.

(5) Duration of the shock in seconds, not including that of the accompanying sound.

(6) Intensity of shock: Was it strong enough (*a*) to make windows, doors, fire-irons, &c., rattle: (*b*) To cause the chair or bed on which the observer was resting to be perceptibly raised or moved: (*c*) To make chandeliers, pictures, &c., swing, or to stop clocks: (*d*) To overthrow ornaments, vases, &c., or cause plaster to fall from the ceiling: (*e*) To throw down chimneys, or make cracks in the walls of buildings?

(7) Sound-phenomena: (*a*) If any unusual rumbling sound was heard at the time of the shock, what did it resemble? (*b*) Did the beginning of the sound precede, coincide with, or follow, the beginning of the shock, and by how many seconds? (*c*) Did the end of the sound precede, coincide with, or follow, the end of the shock, and by how many seconds? (*d*) Did the sound become gradually louder and then die away? (*e*) Were the principal vibrations felt before, at, or after the instant when the sound was loudest?

(8) The names of any other places where the earthquake was noticed would be most useful, together with answers for each place (if possible) to the following questions:—(*a*) Was the shock felt? (*b*) Was it strong enough to make doors, windows, fire-irons, &c., rattle? (*c*) Was any unusual rumbling sound heard at the time of the shock? CHARLES DAVISON.

38, Charlotte Road, Birmingham, August 23.

CHEMISTRY AT THE BRITISH ASSOCIATION.

AFTER the President's address, the first paper was read by Prof. Crum Brown on "Electrolytic Synthesis," descriptive of work carried out in conjunction with Dr. J. Walker.

He showed how, by an extension of the electrolytic methods which had been already fully worked out in relation to potassium acetate, the higher fatty acids of other series could be synthesised. Thus, starting from the ethyl potassium malonate the ether of succinic acid was obtained in considerable quantity and with great readiness. Similarly adipic, sebacic and other ethers had been obtained. Secondary products were formed which in the higher members of the series accumulated in inconveniently large quantities.

Professor Ramsay gave a communication on the "Impurities in Chloroform." He found that when the purest chloroform that could be prepared was exposed to light between the months of March and July, it emitted an acrid odour when opened, due to the formation of phosgene gas. The reaction by which this had been brought about was :—

$$2CHCl_3 + O_2 = 2\ COCl_2 + 2\ HCl.$$

The second day of the meeting was devoted almost entirely to the consideration of the phenomena accompanying the combustion of gases. Messrs. Lean and Bone gave an account of the results obtained in exploding ethylene with less than its own volume of oxygen. They had found that there was always a considerable rise of pressure, and that the resulting products contained, in addition to hydrogen and carbon monoxide, small percentages of carbon dioxide, unsaturated hydrocarbons, and some saturated hydrocarbon, presumably marsh gas.

The unsaturated hydrocarbons consisted largely, if not entirely, of acetylene. Carbon is also formed as a product of the reaction, due in all probability to the decomposition of heavy hydrocarbons into marsh gas and carbon at high temperatures. The experiments show that oxygen combines with carbon in preference to hydrogen.

Prof. Lewes, in his paper on the "Luminosity of Hydrocarbon Flames," described the results of the analyses of the gases drawn from an ordinary coal gas flame at different heights. He had found that the heavy hydrocarbons which occur in the non-luminous part of the flame are almost entirely converted into acetylene before they reach the luminous zone. The luminosity of the flame is, in his opinion, brought about by dissociation of the acetylene, the temperature required for this dissociation varing with the degree of dilution of the acetylene. Under the circumstances already described, where the amount of acetylene present was 1·1 to 1·3 per cent., the temperature was 1200°, whilst in the flame of a paraffin lamp, where about double the amount of acetylene was present, the temperature was found to be 1000°.

On passing ethylene through a heated tube at different temperatures he found that at 900° the chief products were methane and acetylene; at 1000° there was still no hydrogen and no carbon, but more oil and heavy hydrocarbons, whilst at a still higher temperature hydrogen and carbon appeared amongst the products; above 1200° there was much carbon and little or no hydrocarbons. The actual temperature of the gas flame used was 500° at a distance of half an inch above the burner; 1279° at the top of the non-luminous zone, and 1370° at the top of the luminous zone.

Prof. Smithells followed with a number of very beautiful "Experiments on Flame." He held that the ordinary candle flame showed four and not three zones as usually described. He considered that the phenomena of combustion in flames ought to be studied by using gases of simple and definite composition rather than a variable and complex mixture such as coal gas.

He showed, by means of experiments, the two distinct zones in the non-luminous Bunsen flame, and how these could be separated, and their character varied according to the amount of air admitted, and similar illustrations were given by burning a jet of air laden with benzene vapour. Under the conditions of the Bunsen flame he had found that whatever hydrocarbon was used the products withdrawn from the inner cone consisted of carbon monoxide, carbon dioxide, hydrogen, and water vapour, whilst in the case of the benzene flame described, when the air supply was so regulated as to produce a luminous zone between the inner and outer zones, acetylene was found amongst the gases withdrawn from that zone.

His experiments had led him to conclude that when the hydrocarbon is starved of oxygen the carbon burns preferentially to the hydrogen.

Prof. Smithells then introduced a spray of cupric chloride solution into the gas, and showed that the inner flame remained unaltered in appearance, whilst the outer flame became green.

He is of opinion that the decomposition of the salt takes place in the inner flame, and that the colouration of the outer flame is due to the projection of the products of decomposition through the outer flame. A discussion followed these papers, in which Sir G. G. Stokes described the experiments he had performed with a view to determine whether the luminosity of the flame was due to carbon or to hydrocarbons. He was not in favour of the idea that the colouration of the flame was due to chemical reactions taking place within it. Sir Henry Roscoe thought it due to the separation of metal in the flame, and not to the oxide. Prof. Liveing quoted the results of his observations on the spectrum of oxygen, and expressed his adherence to the hydrocarbon theory of luminosity. Prof. Ramsay supported Prof. Smithells' contention. The discussion came to a conclusion with the replies of the authors of the papers.

Dr. J. A. Harker then followed with a description of "The Reaction of Hydrogen with Mixtures of Hydrogen and Chlorine." He finds that as had been previously observed by Horstmann, Bunsen, and others, the hydrogen combines partly with the oxygen and partly with the chlorine, but that the reaction varies with the quantities of the constituent gases present, and takes place in accordance with the law of Guldberg and Waage.

Prof. Clowes gave the results of the investigations which he had taken up in order to produce a safety lamp which should indicate with greater accuracy the presence of inflammable gases and vapours in air. In confirmation of previous observations he had found hydrogen to be by far the most sensitive flame, and he described a means by which hydrogen could be burnt in an ordinary oil safety lamp with greater convenience than had hitherto been possible.

A discussion which was to have been held in conjunction with Section D on the "Chemical Aspects of Bacteriology," fell through.

Prof. Roberts Austen gave a paper on the "Effect of Small Quantities of Foreign Matter on the Properties of Metals." The addition of two-tenths per cent. of lead or bismuth to gold was found to render it quite brittle, whilst extremely small quantities of phosphorus, magnesium, and zinc made nickel malleable. Such phenomena had no doubt been of great interest in ancient times to the alchemist, but to-day they constituted all-important questions for the engineer. Experimenting on gold, which could be obtained more readily than most other metals free from impurities, either solid or gaseous, he found that the tenacity was decreased by the addition of small quantities of elements whose atomic volumes were greater than that of gold, whilst those elements whose atomic volume was the same or smaller than that of gold, increased its tenacity. Lithium and aluminium acted in an exceptional manner. Furthermore, whilst the addition of 10 per cent. of aluminium gave an alloy melting at 400° lower than gold, 23 per cent. of the admixture yielded a brilliant alloy having a higher melting point than gold. He pointed out also that gold during the process of cooling showed abnormalities similar to those shown by iron, which, however, disappeared when the operation was carried out under pressure. Prof. Hartley had found that iron required to be slightly oxidised before it could be melted, even at a temperature which sufficed to melt platinum. He had always found that silver and copper, unless prepared with special precautions which he described, contained gold.

Dr. Gladstone submitted a communication on the "Molecular Refraction and Dispersion of Metallic Carbonyls and of Indium, Gallium and Sulphur." The observations made on a sample of the iron pentacarbonyl supplied to him by Mond indicated an extreme dispersion for iron, even taking the highest value for carbonyl previously recorded. He attributed, however, a still higher value (11·2) to carbonyl, and assigned a chemical formula in accordance therewith. With regard to sulphur he had found that the values obtained varied only slightly, whether the sulphur was in the liquid, solid or gaseous condition. Prof. Liveing found that the same thing held for oxygen and nitrous oxide in the liquid and gaseous conditions, and considered that this pointed to the continuity of the gaseous and liquid states.

Dr. G. H. Bailey gave a paper on "Impurities of Town Air." He pointed out that the amount of air taken into the system daily greatly exceeded that of the liquid and solid food, whilst according to Tyndall expired air was very free indeed from solid particles, and that air was undoubtedly the medium by which many diseases were propagated, and that in towns, as a matter of fact, the death-rate rose to very abnormal proportions during those periods when the air was most polluted. Under these circumstances it was a matter of surprise that so little attention had been devoted in recent years to the determination of the impurities in air. A very large amount of information had, it was true, been obtained relating to the carbonic acid in air, and this had led to valuable results; but with the exception of Dr. Russell's extremely interesting reports, hardly anything had been done in the direction of determining the sulphurous acid and organic matter with which town air, especially at certain seasons, was laden. He then described the methods which had been adopted by the Air Analysis Committee of Manchester for determining these impurities, showing how it was not only possible to arrive at a measure of the amount of suspended organic matter, but also to ascertain proximately how far it was of a noxious character. Such analyses may appropriately be supplemented by a bacteriological examination of air. Some hundreds of analyses of the air of London, Manchester, and Liverpool had been made, and the following conclusions were drawn from them:—(1) That in clear breezy weather the amount of sulphurous acid in town air does not exceed one milliogramme per 100 cubic feet of air. (2) That in antiyclonic periods, and especially in times of fog, diffusion is seriously interfered with, and the quantity has been found as high as 50 milligrammes. (3) That the organic impurities in air also increase under similar conditions to those which promote the accumulation of sulphurous acid to 40 or 50 times their normal amount at least.

In the discussion which followed Sir Douglas Galton expressed himself well satisfied with the enquiry, and hoped that the work would be continued. He called attention to the tendency for decaying matter to collect, especially in certain areas of large towns and the danger of allowing such accumulations. Mr. A. E. Fletcher, Chief Inspector of Alkali Works thought the house fire was a large contributor to the evil and a most difficult one to contend against. He suggested filtering the air for the house through cotton wool filters and had found that it could be applied with great success. Mr. Warrington criticised the methods of analysis and would like to see the determinations extended so as to show in what quantity the respective sulphur compounds existed in the air. Dr. Rideal had found the method of determining sulphurous acid most reliable and preferable to the Gas Referee's test used for the estimation of sulphur in coal gas. Messrs. Hartog, Fairley, Thomas, Dr. Clowes and the President also spoke on the paper, and Dr. Bailey replied to various points which had come up in the discussion.

Subsequently, Prof. W. H. Perkin described methods of synthesis with the aid of butane and pentane tetra-carboxylic ethers the constitution of the methylene ring compounds being illustrated by Prof. Crum Brown by means of a very ingenious set of models.

A number of papers were carried over to the last day of the meeting mainly dealing with atomic weights and analytical work. Amongst these. Prof. Ramsay and Miss Aston contributed the atomic weight of boron (*a*) by determination of the water of crystallization in borax (*b*) by conversion of anhydrous sodium borate into sodium chloride. The value obtained was 10·966. Mr. Hartog drew attention to the results just published of a determination of the atomic weight of boron by the late Dr. Abrahall.

Prof. Ostwald read a communication on the assumed potential difference between metals in the solid and in the molten state. His experiments failed to detect any such difference of potential; it is at any rate below $\frac{1}{1000}$ of a volt. Prof. McLeod showed that the iodides of sulphur, SI_6 and S_2I_2, if they existed at all as chemical compounds, were of a most unstable nature; the only evidence of definite combination having taken place in S_2I_2 was that it melted at a lower temperature than either of its constituents.

BIOLOGY AT THE BRITISH ASSOCIATION.

So many important and interesting papers were submitted to the Organizing Committee of D this year that it was found necessary to divide the section into the three departments of Zoology, Botany, and Physiology. The plan of adjourning for lunch at half-past one, and resuming work again at two, with some attractive papers for the afternoon, was tried and found a success. Practical demonstrations and exhibitions were also given in the afternoons in the laboratories above the lecture-room.

On Thursday, August 4, after the president's address, the following series of reports by committees appointed at the Cardiff meeting was submitted: (1) The Zoology and Botany of the West India Islands; (2) the Naples Zoological Station; (3) Zoology of the Sandwich Islands; (4) Botanical Laboratory at Ceylon; (5) Migration of Birds; (6) Plymouth Laboratory; (7) Deep-Sea Tow-net; (8) Protection of Wild Birds' Eggs. All of these committees have this year been re-appointed with or without grants. Three papers were then taken in the afternoon, viz.: (1) Renewed experiments on the modification of the colours of Lepidopterous larvæ, with exhibition of specimens, by E. B. Poulton, F.R.S.; (2) Prof. Preyer, of Berlin, on the physiology of protoplasm; and (3) Prof. Hartog on the alleged personality of the segments of the nucleus, and Weismann's "Idant" theory of heredity. Prof. Preyer attributed an important part to the absorption of oxygen by the protoplasm in the formation of pseudopodia. Prof. Hartog contended, from previously ascertained facts, and from his own recent researches, that the view that the segments that constitute the young nucleus persist during its maturity is untenable, and that Weismann's "Idant" theory of heredity being founded thereon must necessarily fail.

On Friday, in the Botanical Department, important papers were read by Dr. Scott (on Secondary Tissues in Monocotyledons), Prof. Goebel (on the Simplest Form of Mosses), Prof. Errera (Physiological Action at a Distance), Prof. Bower (Morphology of Spore-bearing Members in Vascular Cryptogams), and others; these will be noticed elsewhere.

In the Department of Physiology there were the following:— (1) Prof. Waymouth Reid gave a paper on Vital Absorption, in which he showed that the older views of Dutrochet and others as to the process being a physical one due to osmosis must be modified in the direction of showing that the vital activity of the cells composing the absorbing membrane must be taken into account. We know that changes are wrought upon substances during the process of absorption, such as the regeneration of serum-albumen from peptone. In the case of the intestine of the rabbit in full digestive activity, one can get evidence of a stream passing from within outwards so long as the tissues are alive. Scraping off the epithelium diminishes the transfer or puts a stop to it. By the addition of pilocarpine to the fluids used, it is possible to reverse the direction of the stream.

(2) Prof. Rosenthal, of Erlangen, read a paper on Animal Heat and Physiological Calorimetry. The apparatus he made use of has an air calorimeter. In fever, produced by injection of putrid matter, he finds that heat production is not augmented; although in a few experiments he made on man he found a small augmentation of heat production.

(3) Dr. Lockhart Gillespie communicated a paper on Proteïd-hydrochlorides, in which he stated that all proteids have an affinity for hydrochlorides, and the lower proteids combine with a greater percentage of HCl than the higher. These results were supported by the amount of silver which is contained in a series of the different proteid salts of silver, the ratio of silver to albumen being highest, and that of silver to peptone being lowest. The different stages of gastric digestion of a meal he finds to be:—1, the amylolytic stage—no free HCl being present, but some combined proteids—duration about ten minutes; 2, combined hydrochloric acid (proteid-hydrochloride)—acidity considerable, no free HCl, small amount of lactic acid present—duration about half an hour; 3, free HCl stage—some free HCl, but mostly combined, lactic acid disappearing; 4, the chief absorption stage—acidity falling, but proportion of free to combined HCl rising—from three to four or five hours; 5, evacuation—propulsion of contents of stomach into duodenum at fourth or fifth hour.

(4) Dr. E. W. Carlier gave an account of the hibernating gland of the hedgehog, which is situated along the cervico-dorsal and in the axillary regions, and attains its maximum dimensions in October—*i.e.*, just at the commencement of hibernation—and its minimum shortly after the animal has awakened from winter sleep. Histological examination shows that towards the close of hibernation many of the cells change. The chromation in the nucleus diminishes, the fat stored in the cell gradually disappears, and finally the whole cell breaks up. Dr. Carlier considers that the hibernating gland is not merely a storehouse for fatty matter, but actually secretes some nutritive material of great service to the animal during its winter sleep.

(5) Dr. G. Mann read a paper on the Functions, Staining Reactions, and Structures of Nuclei, in which he endeavoured to prove that the achromatic elements of a cell are the most important, and that the nuclear chromosomes are organs for the assimilation of food, while the centrosome is a trophic centre for the nucleus.

In the Department of Zoology, the following papers were read:—

(1) Dr. Henry C. McCook (Philadelphia), on the Social Habits of Spiders. This paper considered the claims of certain species of the Araneæ to possess in some degree the communal tendencies of the Social Hymenoptera. The eminent French araneologist, M. Eugène Simon, in his studies of South American spiders, finds a temporary sodality among certain orb-weavers (*Epeira Badelieri*) at the cocooning season, which Dr. McCook thought might be explained by the well-known fact that female spiders when cocooning often choose the same locality and mass their egg-bags, the one mother overlaying the cocoon of another. But this is quite incidental, and occurs with species which are known to be solitary. The close grouping of Simon's *Uloborus republicanus* was regarded as no proof of a sodality, but simply showed an assemblage of snares in proximity which is not uncommon. The gathering of males in groups on the outer lines of the webs is quite what one sees in other species with which there is no departure from the solitary habit. The third example of supposed social spiders (*Anelosinus socialis*) shows characteristics closely resembling those of young spiders of various genera, who will weave around themselves upon the foliage where they lodge a tent of delicate spinning work within which they dwell for a short space, and then scatter, every individual at once assuming the solitary habit. If Simon's observations be here confirmed, we shall have the transfer of this trait of young spiders in many species to the adult period of at least one species. The fact